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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/726,059	11/29/2000	Alan D. Kersey	WEAF---/LWT	8667

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EXAMINER
SUCHECKI, KRYSTYNA

ART UNIT	PAPER NUMBER
2882	

DATE MAILED: 10/07/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

	Application No.	Applicant(s)	
ice Action Summary	09/726,059	KERSEY ET AL.	
	Examin r	**Art Unit**	
	Krystyna Suchecki	2882	

AILING DATE of this communication app ars on the cov r sh et with th correspondence addr ss --

...od for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-31* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-31* is/are rejected.

7)☒ Claim(s) *26 and 30* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *28 February 2001* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Information Disclosure Statement

1. The information disclosure statement filed April 9, 2001 ha references that fail to comply with the provisions of 37 CFR 1.97, 1.98 and MPEP § 609 because some references are not included. It has been placed in the application file, but the references that have not been initialed have not been considered as to the merits. Applicant is advised that the date of any re-submission of any item of information contained in this information disclosure statement or the submission of any missing element(s) will be the date of submission for purposes of determining compliance with the requirements based on the time of filing the statement, including all certification requirements for statements under 37 CFR 1.97(e). See MPEP § 609 ¶ C(1).

Drawings

2. The drawings are objected to under 37 CFR 1.83(a) because they fail to show sensing arrays 24 and 26 (Page 5, lines 23 and 26), housing 28 (Page 5, line 28) as described in the specification. Also, fiber optic cable 30, platform 20 and instrumentation 100 are not shown in Figure 6 (Page 6). Also, the tri-mask splitter of Claim 26 is not shown in any Figure. Any structural detail that is essential for a proper understanding of the disclosed invention should be shown in the drawing. Please ensure that all other elements of the drawings correspond to the Specification. MPEP § 608.02(d). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Claim Objections

3. Claim 1 is objected to because of the following informality: Claim 1 recites the limitation "the pipe" in line 4. A pipe has not been previously introduced in the Claim to give it antecedent, but will be considered as if properly introduced for examination purposes.

4. Claim 13 is objected to because of the following informality: Claim 13 recites the limitation "the optical circulator" in line19. The circulator lacks antecedent basis as it has not been previously introduced in the claim.

5. Claim 26 is objected to because of the following informality: "a tri-mask splitter each optically connected to a photo receiver" is unclear. A single splitter with a single associated receiver cannot be connected in a plurality of instances without explanation. Also, stating that a receiver comprises a receiver and a splitter does not lend a proper limitation to the term "receiver".

6. Claim 30 is objected to because of the following informality: "the optical length of the time delay is substantially and" causes the claim to be improperly written. For examination purposes, Examiner assumes that claim 30 should read: "The apparatus of claim 13 wherein the optical length of the time delay and the nominal optical length of the sensor are each about 1 usec".

7. Appropriate correction is required.

Claim Rejections - 35 USC § 112

8. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

9. Claims 8 and 26 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

10. Claim 8 recites the limitation "DFB laser" in line 21. "DFB laser" is mentioned but is not defined in the specification causing an inadequate antecedent basis, as the acronym requires a clear definition. "DFB" will be interpreted as "distributed feedback" for examination purposes.

11. Claim 26 recites the limitation "tri-mask splitter" in line 24. The specification and drawings do not lend any explanation to the device as to whether the device is made of three masks, formed by three masks to have a specific configuration, splits the signal towards three masks, etc. The lack of clarity as to whether the term "tri-mask" denotes a physical object or a method of making a physical object causes insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 103

12. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

13. Claims 1-7 and 9-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cooper et al. (US 6,212,306) in view of McGuinn (US 6,450,037).

14. Regarding Claim 1, Cooper teaches a method of interrogating at least one fiber optic sensor for monitoring strain, temperature, vibration, pressure or acceleration etc (Column 1, lines29-30) comprising:

a. Generating successive light pulses (Figures 1, 2, 3 and 4);

b. Splitting the light pulses into first and second light pulses (Figure 1, item 16);

c. Delaying the second light pulses a known time period relative to the first pulses (Figures 3 and 4);

d. Combining the first and second light pulses onto a single optical fiber (Figure 1);

e. Directing the first and second light pulses through a first perioding grating of low reflectivity (Column 6, lines 38-42), through the optical sensor and through a second periodic grating of low reflectivity (Figure 1);

f. Receiving reflected first and second light pulses from the first grating (Figure 2);

g. Receiving reflected first and second light pulses from the second grating (Figure 2); and

h. Determining a phase shift between the reflected first light pulses from the second grating and the reflected second pulses from the first grating (Column 8, lines 19-44).

15. Cooper does not teach a method of interrogating a sensor coupled to a pipe, the sensor sensing a parameter of a fluid in the pipe.

16. McGuin et al. teaches a non-intrusive fiber optic pressure sensor for measuring fluid flow in a pipe. McGuinn teaches many configurations and modifications to achieve wavelength and/or time division multiplexing. The teachings of Figure 4 are broadly similar to the above

claim yet the arrangement provides for the measuring of unsteady pressures within a pipe to aide in the exploration and production of oil and gas (Column 1, lines 14-20).

17. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to apply the system and method of Cooper for the purpose of McGuinn in order to provide for the measuring of unsteady pressures within a pipe to aide in the exploration and production of oil and gas (Column 1, lines 14-20). In addition, it has been held that a recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus/method satisfying the claimed structural limitations. *Ex parte Masham*, 2 USPQ2d 1647 (1987).

18. Regarding Claim 2, Cooper teaches the method of claim 1 further comprising:

i. Comparing the phase shift from the successive pulses (Column 7, line 54-Column 8, line 44); and

j. Determining a change in magnitude of the measured parameter from the comparison of the successive phase shifts (Column 8, line 38-44).

19. Regarding Claim 3, Cooper teaches the method of claim 1 further comprising impressing a modulation carrier onto the first light pulses (Columns 7 and 8).

20. Regarding Claim 4, Cooper teaches the method of claim 1 further comprising directing the first and second light pulses along the optical fiber and through a optical splitter (Figure 1, item 16).

21. Regarding Claim 5, Cooper teaches the method of claim 1 wherein the reflected first and second signals are passed through a splitter and are impinged upon an optical receiver (Figure 2).

22. Regarding Claim 6, Cooper teaches the method of claim 1 further comprising directing the second light pulses through a time delay device (Figure 3).

23. Regarding Claim 7, Cooper teaches the method of claim 1 wherein the known time period of delay is about the same as the double-pass time of the light pulses through the sensor (Column 6, lines 57-59).

24. Regarding Claims 9 and 10, Cooper teaches the method of claim 1 wherein generating light pulses and the known time period is about 1 usec in duration (Column 9, lines 34-50).

25. Regarding Claim 11, Cooper teaches the method of claim 1 wherein the first and second periodic gratings are tailored to reflect light having a wavelength of about 1545 nm (Figures 4a-4c).

26. Regarding Claim 12, Cooper teaches the method of claim 1 wherein the successive pulses are generated at about 16 usec intervals (Column 8, lines 12-14).

27. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Cooper and McGuinn in view of Fujiwara (US 5,657,405).

28. Cooper and McGuinn teach the method of Claim 1 above. Cooper additionally teaches generating continuous light (Figure 1, item 12) and pulsing using and integrated optics chip (Column 6, lines 7-18).

29. Neither Cooper nor McGuinn teach the use of a DFB laser.

30. Fujiwara teaches the use of a DFB laser source in optical fiber sensor systems in order to eliminate mode-hopping and increase frequency bandwidths (Column 9, lines6-18).

31. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include a DFB laser in the method of Cooper and McGuinn in order to eliminate mode-hopping and increase frequency bandwidths (Fujiwara, Column 9, lines6-18).

32. Claims 13-14 and 16 rejected under 35 U.S.C. 103(a) as being unpatentable over Cooper in view of Kersey.

33. Regarding Claim 13, Cooper teaches and apparatus for interrogating at least one interferometric fiber optic sensor, the sensor optically connected between a pair of reflective gratings and comprising:

k. A light source (Figure 1, item 12);

l. An optical coupler optically connected to the light source (Figure 1, item 16);

m. An optical path optically connected to the coupler and including a time delay device (Figure 1, item 24);

n. A directional coupler (Figure 1, item 16);

o. An optical transmission cable (Figure 1, item 14) optically connected to an optical circulator (Figure 1, item 16 in participation with item 28) and optically connected to the at least one interferometric fiber optic sensor (Figure 1);

p. A photo receiver optically connected to the circulator (Figure 1, item 44 and Figure 2, item 40); and

q. An interrogator connected to the photo receiver (Figure 2, item 40).

34. Cooper does not teach a second coupler or a directional coupler connected to the second coupler with two optical paths between the first and second couplers.

35. Kersey teaches a multiplicity of options for varying an optical path length (Figures 11, 12 and 26 with text). The variations require multiple couplers and allow two paths to vary concurrently before being coupled to another part of the system. The design of the path varying segment allows for an imbalanced interferometer. The imbalanced interferometer allows for phase shifts in the propagating light which in turn leads to increased sensitivity to weak dynamic Bragg wavelength shifts (Section C, pages 1447-1448).

36. It would have been obvious to one of ordinary skill in the art at the time the invention was made to place an imbalanced interferometer system with two optical paths between two couplers in the system of Cooper to allow for phase shifts in the propagating light which in turn would lead to increased sensitivity to weak dynamic Bragg wavelength shifts (Kersey, Section C, pages 1447-1448).

37. Regarding Claim 14, Cooper teaches several modulation devices (Figures 1-3 and 6).

38. Regarding Claim 16, Cooper teaches a time delay having an optical length and a sensor having a nominal optical length and wherein the optical length of the time delay is substantially the same as twice the nominal optical length of the sensor (Column 6, lines 57-59).

39. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Cooper and Kersey in view of Kluth (US 5,991,026).

40. Cooper and Kersey teach claim 13 above. Cooper additionally teaches the use of an electrical amplifier (Column 9, line 50) but does not teach at what point the signal is amplified.

41. Cooper does not teach the use of an optical amplifier.

42. Kluth teaches the use of an optical amplifier in a fiber optical sensing array so that the light signal can be amplified before entering the arrays of fiber optic sensors. It is well known in the art that an amplifier is used to boost a signal to ensure that the signal can reach its destination.

43. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include an optical amplifer in the system of Cooper and Kersey in order to boost the signal and ensure that the signal can reach its destination.

44. Claims 17-26 and 29-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cooper and Kersey in view of McGuinn.

45. Regarding Claim 17, Cooper teaches an acoustic signal (Column 1, lines 29-30) sensing array having a plurality of sensors (Figure 1) wherein optical power sent from the light source connected to the apparatus travels into the acoustic signal sensing array and reflected pulses are received by the photo receiver relating to an acoustic signal (Figures 1 and 2); a local pressure variation (Column 1, lines 29-30) sensing array having a plurality of sensors wherein optical sent from the light source connected to the apparatus travels into the acoustic signal sensing array and reflected pulses are received by the photo receiver relating to the local pressure variation (Figures 1 and 2).

46. Cooper does not teach the apparatus attached to a pipe, the pipe including fluid flowing therethrough, nor, regarding Claims 20 and 23, the use of the sensors to sense the speed of sound for the fluid within the pipe, nor the velocity of the fluid flow within the pipe.

47. McGuin et al. teaches a non-intrusive fiber optic pressure sensor for measuring fluid flow in a pipe. McGuinn teaches many configurations and modifications to achieve wavelength and/or time division multiplexing. The teachings of Figure 4 show a sensing array wrapped a plurality of turns around a circumference of a pipe. The wrapping arrangement aides in determining pressure changes, vibrations, noises and acoustic oscillations while a fluid flows through a pipe (Column 1, lines 48-59). The arrangement provides for the measuring of unsteady pressures within a pipe to aide in the exploration and production of oil and gas (Column 1, lines 14-20 and 56-59).

48. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to apply the system and method of McGuinn to Cooper in order to provide for the measuring of unsteady pressures within a pipe as well as determining pressure changes, vibrations, noises and acoustic oscillations while a fluid flows through a pipe (Column 1, lines 48-59) to aide in the exploration and production of oil and gas (Column 1, lines 14-20). In addition, it has been held that a recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus/method satisfying the claimed structural limitations. *Ex parte Masham*, 2 USPQ2d 1647 (1987).

49. Regarding Claim 18, Cooper teaches an apparatus wherein the reflective grating reflect the same nominal wavelength (Column 2, lines 19-40).

50. Regarding Claim 19, Cooper teaches the use of fiber Bragg gratings (Column 3, lines 31-33).

51. Regarding Claims 21 and 24, Cooper teaches an arrangement wherein the sensor within the sensing array are spaced a known or determinable distance or distances apart (Column 9, lines 14-33).

52. Regarding Claims 22 and 25, Cooper teaches an arrangement wherein the sensors within the sensing array are spaced a minimum distance apart, understood to include equidistant (Column 6, lines 55-65).

53. Regarding Claim 26, Cooper teaches the use of a splitter and photo receiver optically connected (Figures 1 and 2, items 16, 46, 44).

54. Regarding Claim 29, Cooper teaches gratings tailored to reflect light having a wavelength of about 1545 nm (Figures 4a-4c).

55. Regarding Claim 30, Cooper teaches great flexibility (Column 7, line 3, Column 8, lines 5-13 and Column 9, lines 41-42) in an optical length of a time delay and a nominal optical length of a sensor, including 1 usec (Column 9, lines 41-42).

56. Claims 27-28 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cooper, Kersey and McGuinn in view of Fujiwara .

57. Regarding Claim 27, Cooper and Kersey teach the apparatus of Claim 13 above. Cooper additionally teaches generating continuous light (Figure 1, item 12) and pulsing using and integrated optics chip (Column 6, lines 7-18).

58. Neither Cooper norKersey teach the use of a DFB laser.

59. Fujiwara teaches the use of a DFB laser source in optical fiber sensor systems in order to eliminate mode-hopping and increase frequency bandwidths (Column 9, lines6-18).

60. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include a DFB laser in the method of Cooper and Kersey in order to eliminate mode-hopping and increase frequency bandwidths (Fujiwara, Column 9, lines6-18).

61. Regarding Claim 28, Cooper teaches intervals of about 1 usec in duration (Column 9, lines 34-50).

62. Regarding Claim 31, Cooper teaches intervals of about 16 usec (Column 8, lines 12-14).

Conclusion

63. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Krystyna Suchecki whose telephone number is (703) 305-5424. The examiner can normally be reached on M-F 8-6, with alternating Fridays off,.

64. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Robert Kim can be reached on (703) 305-3492. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9318 for regular communications and (703) 872-9319 for After Final communications.

65. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-4900.

ks
October 1, 2002

ROBERT H. KIM
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